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CLIMATIC PROVINCES OF THE WESTERN UNITED STATES*

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INTRODUCTION

It is recognized that state and national boundaries are generally unsatisfactory lines upon which to base geographic divisions. For the most part the great facts of climate are controlled by features other than those which are used to divide state from state, especially in a region where the state boundaries tend to be straight lines or rivers, neither of which have any significance as a climatic barrier. In the study of the climate of the western part of the United States the necessity constantly arises for a division of the region into smaller units on the basis of the climate, as the conditions are too varied and the area is too large to be considered as a single unit.

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PREVIOUS CLASSIFICATIONS

Supan's Provinces. Many attempts have been made to make a satisfactory classification of the climates of the world or of parts of it.[1] Perhaps the most noteworthy of these attempts are the climatic provinces suggested by Supan, Köppen, Herbertson and Dryer. Under Supan's classification of climates[2] the earth is divided into thirty-five provinces, of which the western United States is included in the following: (1) Northwest American Coastal Province, which has a mild, equable, rainy climate; (2) Californian Province, which is relatively cool, especially in summer, with marked sub-tropical rainy seasons; (3) North American Mountain and Plateau Province, with great annual and daily ranges of temperature, and which is dry. These provinces are shown on a small scale map, and their limits are not accurately defined. From the map the boundaries may be determined approximately. The Northwest American Coastal Province and the Californian Province include all the area west of the Sierra Nevada-Cascade range of mountains and also a part of the coast of southern California. The region of Puget Sound and the Olympic Mountains is included in the Northwest American Coastal Province, all the area south of this region, with the exception of a small district in the extreme southern part of California, is included in the Californian Province. The region east of the mountains is the North American Mountain and Plateau Province.

Köppen's Climates. The classification of climates proposed by Köppen[3] has a botanical basis. It takes into account the climatic variations due to altitude as well as those due to geographical location, and is, therefore, difficult to apply in a general way, although it should be extremely accurate locally. Köppen's map shows the coast mountains from the Strait of Juan de Fuca to San Diego and the Great Valley of California in one general climatic group, which is that of the "mesotherms," plants which require a moderate heat and a moderate amount of moisture. The coast mountains and valleys form a sub-group, the "Heath Climate," which has 30 millimeters (1.2 in.) of rain in the dryest month; in most parts of the region the rainfall in the summer, that is the dry months, is much less than 30 millimeters, so that the classification is weak in this respect, which is, however, a minor one. The Great Valley of California forms a sub-group, the "Olive Climate," with a temperature of 295°A. (72°F.) in the warmest month and 275°A. (36°F.) in the coldest month. It is hard to see any purely climatic reason for separating the southern part of the Great Valley from southern California and retaining in the same group the Olympic Mountains and the coast region of southern California.

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[1] See Ward, R. DeC.: Climate, Putnam, New York, 1908, Chapters I, II, and III.

[2] Supan, A.: Grundzüge der physischen Erdkunde, 5th edit., Leipzig, 1911, pp. 230-234, and Plate XV (translation in Ward's "Climate").

[3] Köppen, W.: Versuch einer Klassifikation der Klimate, *Geogr. Zeitschr.*, Vol. 6, 1900, pp. 593-611 and 657-679.

The Cascade, Klamath, the northern Coast Range, and Sierra Nevada mountains, and the Puget Sound and Willammette valleys are included in the "mikrotherm" group, which requires a smaller total heat and a lower mean annual temperature than the mesotherm group. Except for a narrow strip along the Cascade crest, which has the "Birch Climate," the whole of this group in the western United States is included in the sub-group of the "Oak Climate," with a mean temperature of more than 283°A. (50°F.) for four months, and a difference between the mean temperatures of the warmest and the coldest month of 10°A. (18°F.). There is a small part of the area of the Birch Climate extending into the Arctic conditions.

The whole area east of the Sierra Nevada-Cascade range, except for isolated areas in river valleys and at higher elevations, is included in the "xerophyte" group, which is a region of little moisture and high temperatures, at least for a short season. Southeastern California and western Arizona form the "Sandstorm Climate," central Arizona lies in the "Mesquite Climate" sub-group, eastern Arizona and New Mexico are in the "High Savanna Climate," and Nevada and Utah have the type of climate known as the "Prairie Climate." Eastern Oregon and Washington lie largely in the "Maize Climate" of the mesotherm group, and the "Oak Climate" of the mikrotherm group.

This classification is ingenious and capable of being worked out in great detail, but as far as the western United States is concerned it does not seem to agree with the climatic facts; for example, there is no part of California west of the mountains in which nearly as much as 30 millimeters of rain falls in the driest month. On the other hand the major groups may be regarded as representing climatic regions which have more or less similar characteristics. This classification does not seem to be as useful as that of Supan or that of Herbertson.

Herbertson's Major Natural Regions. Herbertson's "Major Natural Regions"[4] are an attempt to divide the surface of the earth into natural provinces and, while climate plays an important part in the choice of regions and of boundaries, climate is only one of the controls which are considered. In addition to the attempt to make a series of provinces, Herbertson has attempted to make a series of classes which shall bring like climatic provinces into groups, and in this he has been remarkably successful. In this classification the western United States is included in the "Warm Temperate" and the "Cool Temperate Lands," with the exception of the southern part of California and western Arizona, which is grouped with the "Hot Lands." The Cool Temperate Lands are described as having cool summers and cold or mild winters; in the western United States this region is divided into the Western Margin Type, which is the region west of the Cascades, and the Interior Highlands Type, which is the region extending eastward from the Cascades to the Rocky Mountain front or beyond. The Western Margin Type of climate is characterized by heavy rainfall, particularly in winter; the Interior Highland climates have a much lighter rainfall and greater extremes of temperature.

The Warm Temperate Lands are warmer both in summer and in winter than the Cool Temperate Lands. The Western Margin Type of climate in the United States in this belt is the area west of the Sierra Nevada and the mountains of southern California. It is a region of mild temperatures and winter rains. The plateau type of climate in this belt in the United States includes the states of Nevada, Utah, New Mexico, and the eastern part of Arizona; it consists of lofty mountains enclosing plateaus of extreme aridity: the only fertile portions are the river valleys and such areas as can be irrigated. Southeastern California and the greater part of Arizona are part of the Hot Lands; the region is located in the West Tropical Desert Type of this belt. It is characterized by extreme aridity and large ranges of temperature.

Dryer's Natural Provinces. A classification has recently been made by Dryer[5] which has many of the characteristics of Supan's provinces, although the grouping suggests the Major Natural Regions of Herbertson. In this classification the western United

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[4] Herbertson, A. J.: The Major Natural Regions, *Geogr. Journ.*, Vol. 25, 1905, pp. 300-309. See also revised chart in Herbertson's The Senior Geography, Oxford, 1909 (The Oxford Geographies, Vol. 3).

[5] Dryer, C. R.: High School Geography, New York, etc., 1912, pp. 328-330 and 358.

States is included in four provinces, Oregon, California, American Interior, and Arizonan. These provinces are contained in zonal groups as follows: Oregon and Interior in a zone known as the Temperate and Intemperate, Californian and Arizonan in the Subtropical and Warm Temperate Zone. The Cold Temperate Zone lies wholly to the north of the Canadian border and the Intertropical Zone is wholly south of the Mexican boundary in this region.

The Temperate and Intemperate Provinces are characterized by climates suitable to summer forests and coniferous forests and grass-land. The Oregon type of climate has a small range of temperature; all seasons are temperate, and the rainfall is from twenty to one hundred inches annually with excess in winter. The Interior type has extreme ranges of temperature and a rainfall of less than twenty inches (500 mm.).

The Subtropical and Warm Temperate Provinces are hot with a temperate season or temperate with a hot season. The Arizonan type of climate is a desert; the rainfall is less than ten inches (250 mm.); the daily range of temperature is far in excess of the annual. The Californian type has a small range of temperature and a rainfall of twenty to sixty inches (500 to 1500 mm.) annually with dry summers. This type of climate supports dry tropical forest and poor grass-land. It is a region of equable temperatures, clear skies, absence of storms, and dry, stimulating air.

The limits of these provinces are somewhat as follows: the Oregon and Californian provinces extend from the Pacific Ocean eastward to beyond the Cascade, Sierra Nevada, and southern California mountains; the division between the two provinces is drawn at about latitude 41°; the American Interior Province includes the Rocky Mountains and the Columbia Plateau or Snake River Lava Plains; the line between this province and the Arizonan follows the northern boundary of Nevada and Utah and the eastern edge of the Great Basin and the Colorado River Plateau in western Colorado and New Mexico.

Except that the coast region of California cannot be said to be hot at any season and that the rainfall is considerably less than twenty inches in many parts of the state, the descriptions are in accord with the general facts of climate in the region. In the Interior and Arizonan provinces the rainfall is locally in excess of the amounts indicated because of the topography, but the amounts are correct for the general conditions. Perhaps there is more resemblance between the Oregon and the Californian and between the Interior and the Arizonan provinces than there is within the zones in which the provinces are grouped, but from a world-wide point of view the grouping by zones seems to be justified. Dryer's classification has the logical arrangement of the Major Natural Regions and in the western United States the boundaries of the provinces seem to be better located than the boundaries of these divisions.

Henry's Rainfall Types. In the "Climatology of the United States"[6] Henry has recognized the following rainfall types for the western United States: Pacific, Sub-Pacific, and Arizonan. The Pacific type of rainfall occurs over all the territory west of the Sierra Nevada and Cascade ranges and in the coast region of southern California, and also obtains in a fringe of country to the eastward of the mountain summits. The distinguishing characteristic is a wet season extending from October to March and a practically rainless summer, except in northern California and parts of Oregon and Washington. About half the yearly precipitation comes in the months of December, January, and February, the remaining half being distributed through the seven months of September to November and March to June. (See Figures 3 and 4 for examples of this rainfall type.) The Sub-Pacific type of rainfall is that which obtains over eastern Washington, Idaho, Nevada, and Utah. There is not, as in the Pacific type, a steady diminution of winter precipitation with the approach of spring, but rather an increase which culminates in the late spring months. (This rainfall type is shown by Spokane in Figure 2.) The Arizona type prevails over Arizona, New Mexico, and a small portion of southern Utah and Nevada. This type differs from all others in the fact that about thirty-five per cent of the rain falls in July and August. May and June are generally the months of least rainfall. (The rainfall at Needles, in Figure 2, shows this type not very clearly developed.) The summer rains are believed to be due chiefly to local convection on the mountains, and the winter rains to general cyclonic movements.

While these divisions by rainfall types do not represent the climatic features of the regions, they form a basis for division which for many purposes is wholly satisfactory. Probably the seasonal distribution of rainfall furnishes the surest means for grouping the climates of the western United States. Henry has not shown the boundaries of the different types, and no attempt is made here to determine where these boundaries are to be found beyond the general statements of the areas included in each type.

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[6] Henry, A. J.: The Climatology of the United States, *U. S. Weather Bureau Bull. Q*, 1906, p. 50. See also *idem:* The Rainfall of the United States, *U. S. Weather Bureau Bull. D*, 1897, p. 11-12.

BASES OF CLASSIFICATION

An examination of the climatic provinces which have been suggested for the United States shows that the bases for the classifications are limited to temperature and rainfall conditions, which are by far the most important climatic factors. It is also true that, if the climatic data of regions which form homogeneous climatic units are examined, the general rainfall or temperature conditions will be found to be more or less similar; and if these homogeneous regions are compared with other homogeneous regions differences will generally appear either in the temperature or rainfall conditions or in a combination of these factors.

Any satisfactory grouping of localities on a climatic basis must take into account the actual temperatures, ranges of temperature, rainfall amounts and the distribution of rainfall through the year. It is practicable for some purposes to establish temperature provinces or zones, and also to establish rainfall provinces or regions; but, for a statement of climatic divisions which will throw places with similar climates into the same group and places with dissimilar climates into different groups, temperature and rainfall conditions must both be included.

In the western United States the greatest climatic differences are not those which are to be found in going from a lower to a higher latitude; the most marked differences are those which exist between the conditions east of the Sierra-Cascade range and the conditions west of these mountains near the Pacific Ocean. In the eastern division the summers are hot and the winters are cold; in the western division the temperatures (at least the sensible temperatures) are mild throughout the year. On the eastern and the western sides of the mountains there are important and marked differences in the annual rainfall, the amount being much greater on the Pacific side than on the eastern side. West of the mountains a winter maximum of rainfall is to be found, but to the east the maximum is more apt to occur in the spring or even in the summer months.

CLIMATIC PROVINCES

Any attempt to separate the western United States into climatic provinces must take into account the importance of the Sierra-Cascade range as a climatic divide. West of this divide the differences in climatic conditions are so gradual in passing from one part of the area to another and the general conditions are so similar that it seems best to include the whole region in a single province, which may be subdivided for detailed consideration. This general province west of the mountains may be termed the ''Pacific Province.'' It includes all the continental United States, except Alaska, west of the Cascade and Sierra Nevada mountains, and also that part of California south of the Tehachapi Mountains[7] and west of the crest of the mountains of southern California, designated by Fairbanks as the Peninsula Range.[8] The outlines of the province are shown by the map, Figure 1. This province forms a continuous strip from San Diego to the Strait of Juan de Fuca, between the mountains and the ocean. This province varies greatly in width and includes many different types of topography, but it represents a more or less definite group of conditions and may, therefore, properly be considered as a climatic unit. The more important climatic features of the province may be stated briefly as follows: generally mild temperatures; marked subtropical winter maximum of rainfall, summers dry or with light cyclonic rains, except in the mountains where summer thunder-showers may occur.

East of the mountain crest line is a region markedly drier than the Pacific Province in the same latitude. The differences between the northern and the southern part of this region are much smaller than those between mountains and lower lands in close proximity to it, so that it is scarcely desirable to separate it into two or more major provinces. No greater differences exist between the different latitudes of this area than are to be found between San Diego and Seattle, for example. Locally and in the northern part of the region the mean annual rainfall is greater than that of the southern part of the Pacific Province; but, as its characteristic feature is deficient precipitation, especially when compared with the same latitude west of the mountains, this province may fitly be named the ''Rain Shadow Area.'' It includes all the region east of the Sierra-Cascade crest and west of the Rocky Mountains, the

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[7] The Tehachapi Mountains limit the southern end of the Great Valley of California; this range is generally considered as the dividing line between northern and southern California.

[8] Fairbanks, H. W.: The Geography of California. San Francisco, 1912, p. 112.

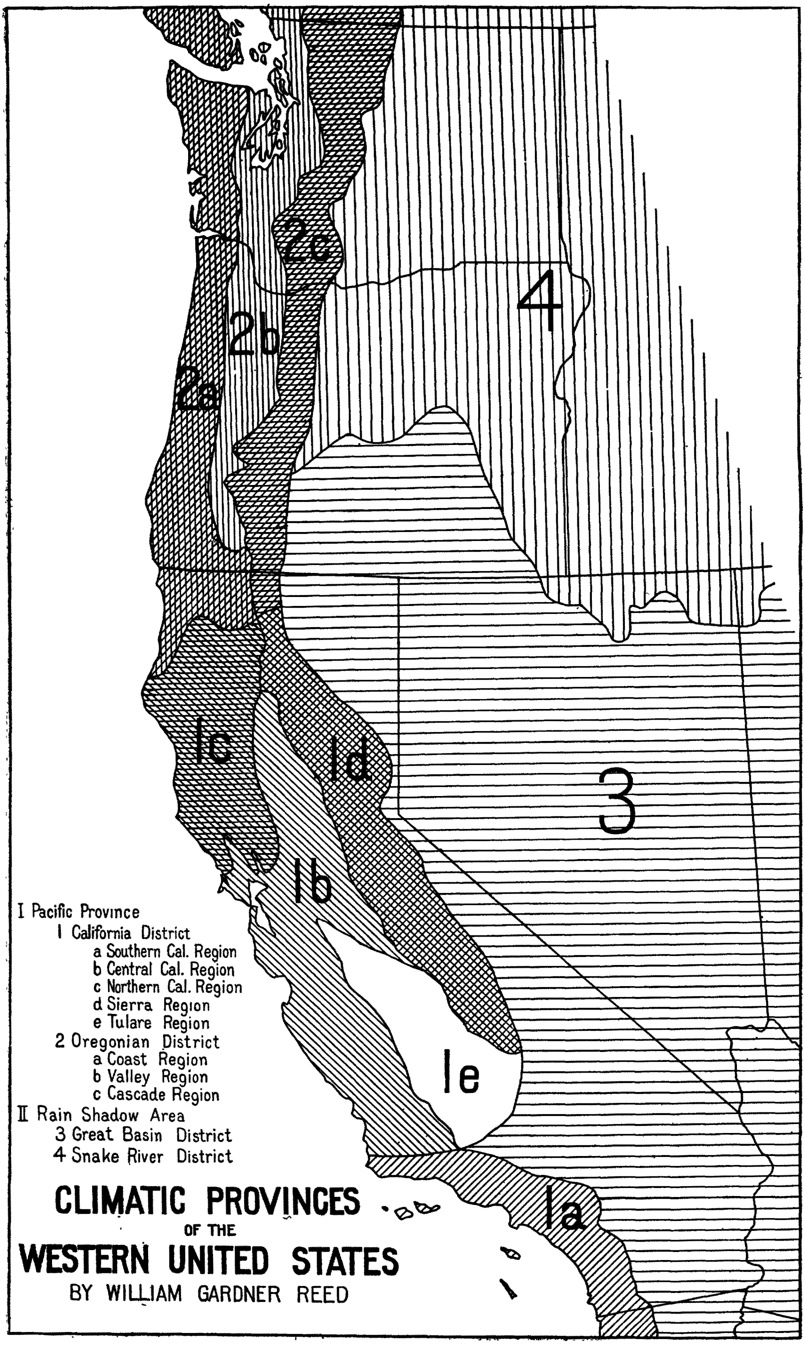

FIG. 1—Scale, 1:10,500,000.

Colorado and Mojave Deserts in southern California, and also all of Arizona and the western part of New Mexico. No attempt has been made to determine accurately the eastern boundary of the province, as the data are few and the purpose of this study has been merely to establish a series of satisfactory climatic provinces for the Pacific Coast states. The map shows only the states bordering on the Pacific Ocean and Nevada, but it is certain that the Rain Shadow Area extends considerably farther east than the limits of the map, especially in the south. The climatic characteristics of the province are large diurnal and annual ranges of temperature, and generally deficient precipitation, arid in the south and semi-arid in the north.

SUBDIVISIONS

Rain Shadow Area. The Rain Shadow Area may be divided into two sub-provinces, which may be termed districts.[9] The basis for the subdivision must be mainly that of rainfall, although higher temperatures are found in the southern part of the province as a rule. There is also a difference in the seasonal distribution of rainfall; in most of the southern portion Henry's Arizona type of rainfall is the rule, although not as clearly developed as in the portion of the province not shown on the map (see curve of annual march of rainfall at Needles, California, Figure 2), while in the northern portion the rainfall is of the Sub-Pacific type (see the curve for Spokane, Washington, Figure 2). In general the southern part of the province has an annual average rainfall of less than ten inches (250 mm.) and the northern part more than ten inches; but there are so many local influences, such as altitude, which are exceedingly important as affecting the amount of rainfall, and the stations are so widely scattered that this does not form a satisfactory division.

The wide areas between stations make the definite establishment of the boundary very difficult. As there is a very definite drainage boundary which falls somewhere in the vicinity of the meteorological boundary between the northern and southern parts of the area, it has seemed best to follow this line, which is the divide between the streams flowing to the Pacific Ocean through the Columbia River and the streams which do not flow to the ocean. The area which is drained through the Colorado River lies well to the south and there is no danger of a complication from the fact that the Colorado reaches the ocean. This boundary is in a sense climatic as the question of interior or exterior drainage depends mainly upon the relation between precipitation and evaporation. On this basis it is possible to divide the province into two satisfactory areas; these are the Snake River District in the north and the Great Basin District in the south. Whether Arizona and New Mexico belong to the Great Basin District or to a third district has not been determined, neither has the relation of Utah to the districts been completely ascertained. The climatic characteristics of the Great Basin District, besides the general characteristics of the Rain Shadow Area, are high maximum temperatures and annual rainfall generally less than ten inches (250 mm.), mostly of the Arizona type of seasonal distribution, especially in the southern portion. The Snake River District has an annual rainfall of ten to twenty inches (250 to 500 mm.), somewhat greater in the mountains, with the Sub-Pacific type of seasonal distribution. It does not seem practicable to carry subdivision of the Rain Shadow Area further than the two districts, as the controls of local climate in the region are topographic rather than areal, and, therefore, similar conditions occur in more or less separated places.

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[9] There are some grounds for believing that a third district will be required if Arizona and New Mexico are included.

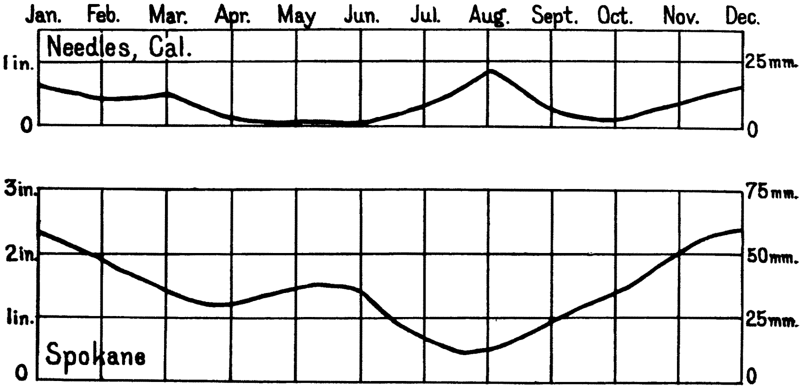

FIG. 2.

Annual march of rainfall in the Rain Shadow Area.

Needles, California, Great Basin District, Arizona type of seasonal distribution, poorly developed.

Spokane, Washington, Snake River District, Sub-Pacific type of seasonal distribution.

Pacific Province. The Pacific Province is composed of a considerable number of areas which differ climatically from each other in one or more respects. It is, therefore, desirable to subdivide this province to suit these areas. If the northern and the southern parts of the province are compared certain differences appear; these are principally somewhat lower temperatures, the common occurrence of snow at low altitudes in winter and of light cyclonic rains in summer in the northern part and not in the southern part of the province. Of these phenomena temperature must be discarded at once, as any division of the province on a temperature basis must be arbitrary and illogical, because of the slight differences between the different parts of the province and the occurrence of temperatures in the mountains of the southern portion which are like those at lower altitudes farther north. There remains the occurrence of snow and of summer rains under cyclonic control. Fortunately the usual limits of these two phenomena are approximately the same, and this line furnishes an entirely logical division of the province into two districts, the California District in the south and the Oregonian District in the north. In the Californian

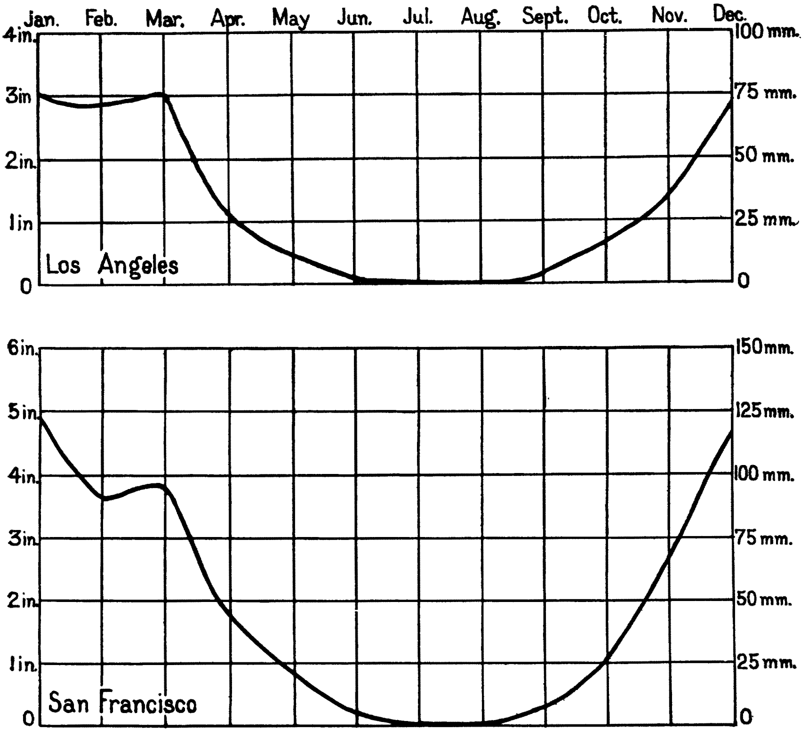

Fig. 3.

Annual march of rainfall in the Californian District of the Pacific Province.
Los Angeles, California, Southern California Region.
San Francisco, California, Central California Region, Pacific type of seasonal distribution.

District summer thunder-showers may occur in the Sierra Nevada mountains, but these may be regarded as local storms and are not the same as the cyclonic summer rains of the Oregonian District.

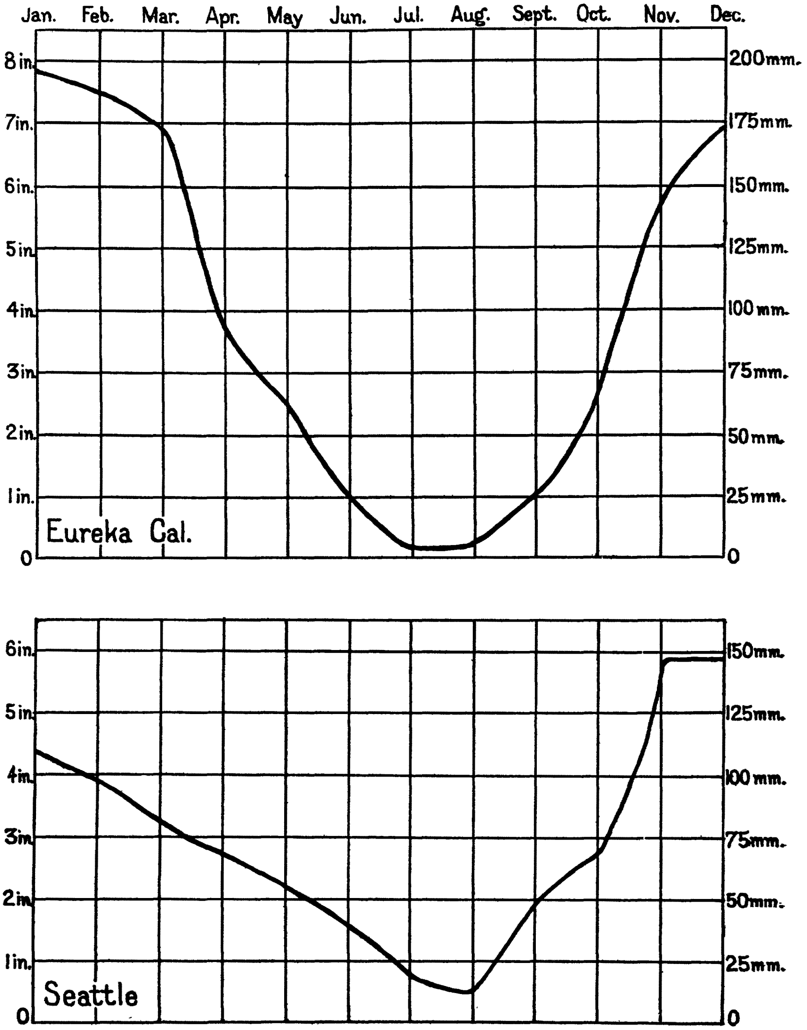

FIG. 4.

Annual march of rainfall in the Oregonian District of the Pacific Province.
Eureka, California, Coast Region,
Seattle, Washington, Valley Region, Pacific type of seasonal distribution.

The dividing line, as shown on the map, has been drawn between stations having significant rainfall in the summer months and those in which July and August are characteristically dry. (See the curves of annual march of rainfall in the Pacific Province, Figures 3 and 4.) This involves an examination of the records of the stations by months, as the averages in many cases have been influenced by the occurrence of single heavy falls of rain so that they show significant amounts although the monthly record shows that for most of the years July and August have been quite dry. The division line lies south of the Lava Plateau and the Klamath Mountains; it reaches the coast at a point somewhat south of Eureka. The Californian District is characterized by generally mild temperatures, winter rains under cyclonic control and dry summers except for local thunder-showers in the higher mountains. The Oregonian District is characterized by generally mild temperatures, winter maximum of rainfall under cyclonic control and light cyclonic rains in summer.

Divisions of the Californian District. Unlike the Rain Shadow Area the districts of the Pacific Province may be further divided into satisfactory climatic areas. The climates of these areas are controlled by the ''meteorological latitude,'' the topography, and the relations to the Pacific Ocean. The Californian District may logically be subdivided into the following climatic regions: the Southern California Region, the Central California Region, the Northern California Region, the Sierra Region, and the Tulare Region.

The Southern California Region includes the portion of California west of the crest of the Peninsula Mountains and south of the Tehachapi Mountains and their western extension, the Santa Ynez Mountains. The region lies on the southern and western slopes of the mountains and the coastal plain along the Pacific Ocean. The characteristics which distinguish it from the other regions of the Californian District are the dry summer of three or four months' duration and an annual rainfall of generally less than twenty inches (500 mm.). (The rainfall curve for Los Angeles, Figure 3, is typical for this region.) Locally in the mountains this amount may be exceeded, but the region is one of light to deficient rainfall and the rain which falls occurs under a winter régime. Snow is very rare and frost is by no means an annual phenomenon.

The Central California Region includes the Coast Ranges and the valleys west of the Great Valley south of San Francisco Bay, the Santa Rosa and Napa valleys which enter San Francisco Bay from the north, and the Great Valley of California north of the annual isohyet of ten inches (250 mm.), which crosses the valley from southeast to northwest near Merced. This region has a dry summer of about two months' duration and an annual rainfall of from ten to thirty inches (250 to 750 mm.), which is greatly exceeded locally in the Santa Cruz Mountains and elsewhere. (A typical curve of the annual march of rainfall in this region is that for San Francisco, Figure 3.) Snow occurs occasionally and frost is usually recorded once or oftener each year. The region is the largest of the Californian District, and it may be said to have the typical or average California climate, if there is any such.

The Northern California Region includes the Coast Ranges north of San Francisco Bay to the northern boundary of the Californian District, except the Santa Rosa and Napa valleys. It has an annual rainfall of more than thirty inches (750 mm.). In other respects it is similar to the Central California Region, except that the temperatures are somewhat lower and frosts and snow more common. There is also a greater tendency to summer rain, although summer rains are not the normal occurrence in the region.

The Sierra Region includes the Sierra Nevada mountains from the foothills of the Great Valley eastward, except that where the annual isohyet of ten inches (250 mm.) passes from the foothills to the mountain slope the boundary follows the isohyet. This region is separated from the Northern California Region by the Sacramento River, as there is no definite logical boundary although the climates of the two regions are somewhat different. The Sierra Region is characterized by an annual rainfall greater than that of the Great Valley in the same latitude, most of which falls in the form of snow. In many parts of the region summer thundershowers are not uncommon. The temperatures are somewhat lower than in the other regions of the Californian District and the climate is of the mountain type.

The Tulare Region includes the southern end of the Great Valley of California, that is the upper San Joaquin Valley and the Tulare Basin, and also the dry mountains to the south and southeast of the Tulare Basin. It has an annual rainfall of less than ten inches (250 mm.) and the ranges of temperature are larger than elsewhere in the Californian District. The climatic conditions in this region are in many respects like those of the desert region on the south and southeast side of the mountains, the crest line of which forms the boundary between the Pacific Province and the Rain Shadow Area, except that the summer rains, sometimes of a torrential type, "cloudbursts," are not common enough to make the curves of average rainfall resemble those of the desert. From a large part of the Tulare Region, the Tulare Basin, the drainage does not reach the ocean.

Divisions of the Oregonian District. The Oregonian District does not fall as readily into climatic regions as the Californian District. There are, however, three belts parallel to the coast which are characterized by climatic differences, the chief of which is probably the average annual amount of precipitation. The difficulty in fixing accurately the climatic boundaries in the district has led to the adoption of topographic boundaries. There are climatic boundaries, however, which probably are more or less coincident with the topographic boundaries selected, as the climatic differences are largely under topographic control. There can be little doubt that the most satisfactory climatic regions in the Oregonian District are the Coast Region, the Valley Region, and the Cascade Region. From the data available there seems to be no reason for any subdivision of the district along latitude lines, except that the area south of the Valley Region, the Klamath Mountains, has been included in the Coast Region; otherwise the conditions from north to south in each region are relatively constant.

The Coast Region includes the Klamath Mountains, the Coast Ranges in Oregon and Washington, and the Olympic Peninsula. The boundary of the region as shown on the map has been drawn from the Cascade Range south of the Rogue River Valley, which seems to have about the same climate as the Willamette Valley, although topographically more or less distinct; along the western portion of the line of valleys the boundary has been drawn as nearly as may be at the crest of the eastern of the ridges of the Coast Mountains, which is the western limit of the valleys. The map shows Vancouver Island as a part of the Coast Region; perhaps the Pacific Province should not be extended north of the Straight of Juan de Fuca. It is certain that there is an Alaskan Province, but no attempt has been made at this time to determine its southern limit beyond the fact that it is not farther south than the International Boundary. The characteristic feature which distinguishes the Coast Region from the other regions of the Oregonian District is its heavy to excessive annual rainfall, generally more than sixty inches. (The curve for Eureka, Figure 4, is typical for the southern part of the region.) Especially at the higher altitudes there is a good deal of snow. Temperatures are mild and temperature ranges small.

The Valley Region is essentially the floor of the Puget Sound and Willamette valleys and the smaller valleys to the south. Its western and southern boundary is that of the Coast Region; its eastern boundary may be taken as the isohyet of forty inches in the Cascade foothills and the southward extension of this line. The chief climatic characteristic of the region, aside from those of the province and the district, is the smaller annual rainfall than the Coast Region or the Cascade Region. (The curve of the annual march of rainfall at Seattle, Figure 4, shows typical rainfall conditions for the Valley Region.) The temperature régime is moderate, particularly in the Puget Sound area.

The Cascade Region is the eastern part of the Oregonian District; it consists of the Cascade Mountains from the annual isohyet of forty inches (1000 mm.) along the foothills to the crest-line of the mountains, which forms the eastern boundary of the Pacific Province. In the south the boundary between this region and the Coast Region cannot be determined with accuracy; it has been drawn on the map as a line connecting the eastern border of the Valley Region with the boundary between the Northern California Region and the Sierra Region of the Californian District, which is the Sacramento River. The Cascade Region is characterized by an average annual rainfall greater than that of the Valley Region, more than forty inches (1000 mm.), with the exception of the southern part of the region; much of the precipitation is in the form of snow; a large part of the rainfall is in the winter. Temperatures are somewhat lower than in the two regions to the west and ranges are greater, although not as large as the ranges in the Snake River District to the east of the mountains.

SUMMARY AND CONCLUSION

None of the published climatic provinces of the western United States are satisfactory. A new grouping of this part of the country into two provinces is suggested. The provinces are as follows: a Pacific Province which includes all the region west from the crest of the Cascade, Sierra Nevada, and Peninsula mountains to the Pacific Ocean, and a Rain Shadow Area which includes the region east from this crest-line to the eastern boundary of the region under discussion. This eastern boundary has been left undetermined, but it is somewhere in the vicinity of the Rocky Mountains. The Pacific Province is characterized by marked subtropical winter rains and dry or nearly dry summers; the Rain Shadow Area has large diurnal and annual ranges of temperature and generally deficient precipitation.

The Rain Shadow Area may be divided into two districts: the Great Basin District is all the territory covered by the province south of the water-parting between the Columbia River drainage and the interior drainage; the Snake River District is all the province north of this line. The Great Basin District has high maximum temperatures and an annual rainfall of generally less than ten inches (250 mm.); the Snake River District has an annual rainfall of ten to twenty inches (250 to 500 mm.) with the Sub-Pacific type of seasonal distribution.

The Pacific Province may be divided by the line which separates the portion of the province having generally dry summers from that part in which light cyclonic rains are not uncommon in summer. The district south of this line, which is in northern California south of the Klamath Mountains, is the Californian District; the district north of the line, western Washington, western Oregon, and northern California, is the Oregonian District.

Each of these districts of the Pacific Province may be subdivided into climatic regions. The climatic regions of the Californian District are five in number: the Southern California Region, which includes all the Pacific Province south of the Tehachapi and Santa Ynez mountains; the Central California Region, which includes the Coast Ranges south of San Francisco Bay and also the Sacramento Valley; the Northern California Region, which includes the Coast Ranges north of San Francisco Bay; the Sierra Region, which includes the Sierra Nevada mountains, except the extreme southern part of the range; and the Tulare Region, which includes the southern end of the Great Valley of California and the north and northwest slopes of the Tehachapi Mountains. The Southern California Region has a dry summer of three or four months' duration with an annual rainfall of generally less than twenty inches (500 mm.). The Central California Region has a dry summer of about two months' duration with an annual rainfall of ten to thirty inches (250 to 750 mm.). The Northern California Region has an annual rainfall of more than thirty inches (750 mm.). The Sierra Region has an annual rainfall greater than that of the Great Valley in the same latitude; most of the precipitation occurs as snow. The Tulare Region has an annual rainfall of less than ten inches (250 mm.) and larger temperature ranges than elsewhere in the Pacific Province.

The Oregonian District may be subdivided into three climatic regions: the Coast Region includes the Klamath Mountains and all the area west of the western boundary of the Puget Sound-Willamette valley; the Valley Region includes these two valleys and the minor valleys in southern Oregon; and the Cascade Region is the Cascade Mountains from the foothills east of the valleys to the crest of the range, which is the eastern boundary of the Pacific Province. The Coast Region has a heavy to excessive annual rainfall. The Valley Region has a smaller annual rainfall than either the Coast Region or the Cascade Region. The Cascade Region has an annual rainfall which is between that of the Valley Region and that of the Coast Region in amount; this region has more snow than the Coast Region.

The foregoing climatic provinces have been made in an attempt to divide the western United States in such a way that areas with similar climatic conditions shall fall within the same general group and that areas with essentially different climatic conditions shall be kept separate. The boundaries are probably subject to considerable readjustment and perhaps other divisions would be recognized. From the use which has already been made of these divisions they seem to be more logical and of greater practical value for the description and study of this portion of the country than any of the previous groupings.

HOW AMERICAN CITIES GROW

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Astonishing are the differences in the growth of American cities, and astonishing, too, is the distinctness with which that growth responds to the nature and extent of each city's sustenance space, its tributary district. New York, the colossal, stands without peer, towering above all other cities in size, just as it stands apart in the service it is able to render to a continent. Only the economic and commercial capital of English America could stand so alone. Only the unique Mohawk gap in the Appalachian upland, that parts the Mississippi from the Atlantic coast, has made possible New York's pre-eminence as the market of a hundred million people. Fig. 1 shows this fitly.

At no time in the last seventy years has any other American city had half the population that New York has had at the same time. The six cities shown in Fig. 1 are the greatest in North America. Any others—there were fifty that passed the hundred thousand mark in 1910—would have the lines that show their